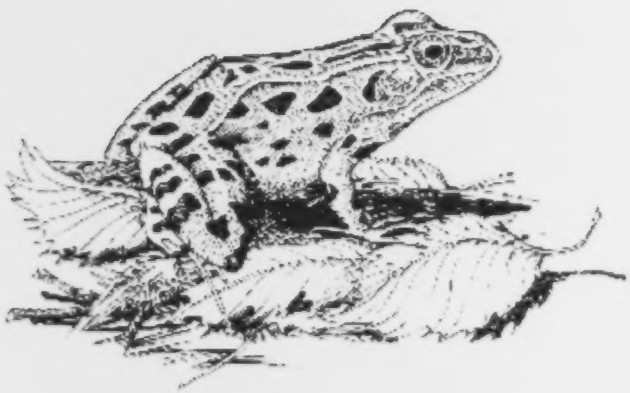
Fish & Wildlife Division

WILDLIFE CONSERVATION AND BIODIVERSITY SECTION

Northern Leopard Frog Reintroduction

Year 4 (2002)



Alberta Species at Risk Report No. 78

Alberta
SUSTAINABLE RESOURCE DEVELOPMENT

Northern Leopard Frog Reintroduction

Year 4 (2002)

Kris Kendell

Alberta Species at Risk Report No. 78

November 2003

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EXECUTIVE SUMMARY

The northern leopard frog (*Rana pipiens*) was once a common and widespread amphibian found throughout central and southern Alberta. During the late 1970s, the leopard frog experienced a dramatic decline in distribution and numbers over much of its historic range in Alberta and is currently designated as Threatened under Alberta's *Wildlife Act*.

The leopard frog has demonstrated little ability to naturally repopulate historical parts of its range. As a result, in 1998, the Alberta Fish and Wildlife Division began to explore the feasibility of reintroducing leopard frogs into habitats within their historical range in the upper Red Deer River and North Saskatchewan River drainages. With the information gathered, the Alberta Conservation Association initiated a pilot reintroduction project in 1999 at the Raven Brood Trout Station near Caroline, Alberta. The project involves the captive rearing of leopard frogs from egg stage of development to metamorphosed frog, in two man-made outdoor ponds at the Raven Brood Trout Station.

To date nearly 10,000 captive-reared leopard frogs have been released at designated sites near Caroline, Rocky Mountain House, and Red Deer, Alberta. All frogs were marked using a Visible Implant Elastomer tagging system prior to release, allowing researchers to monitor the dispersal of released frogs. Frog observations and evidence of breeding activity indicate preliminary success of the project at the initial release site near Caroline and 2001 pilot release site near Rocky Mountain House.

1.0 INTRODUCTION

Typically, the northern leopard frog is a green or brown frog that may obtain a body length of up to 13.0 cm (5.1 in). It can be easily identified from the other frog species found in Alberta by its large black spots that are bordered with pale rings. A further diagnostic feature of the leopard frog is the presence of two prominent lightly coloured ridges, which run the length of the frog's body, from the eye to the groin, on either side of the backbone (Photo 1).

Photo 1. Brown colour phase of the northern leopard frog.

The leopard frog was once a common amphibian found throughout central and southern Alberta. During the late 1970s, the leopard frog experienced a dramatic decline in distribution and numbers over much of its historic range in Alberta (Roberts 1981, 1994, Wagner 1997, Seburn and Seburn 1998, Kendell 2002c). Today, the leopard frog is designated as Threatened under Alberta's *Wildlife Act* and historical natural populations are extirpated from the upper Red Deer River and the North Saskatchewan River drainage.

In 1998, the Alberta Fish and Wildlife Division began to explore the feasibility of reintroducing leopard frogs into formerly occupied habitats in the upper Red Deer River and North Saskatchewan River drainages (Fisher 1999). With the information gathered, the Alberta Conservation Association (ACA) initiated a pilot reintroduction project in 1999 at the Raven Brood Trout Station near Caroline, Alberta. The project involves the captive rearing of leopard frogs from egg stage of development to fully metamorphosed frog, in two man-made outdoor ponds at the Raven Brood Trout Station.

Factors responsible for the decline of leopard frog are not fully understood, but it is generally believed that drought and habitat loss, degradation and fragmentation have played a role. Red leg disease and chytrid fungus, along with the effects of pesticides and herbicides, have also been implicated as possible causal factors of the decline.

Today, remnant-breeding populations of frogs remain vulnerable to disturbance, disease and natural disasters such as drought, flooding and winterkills. The re-establishment of leopard frogs into these former areas of its range will be dependent on transplanting individuals from existing populations in southern Alberta. (Cottonwood Consultants 1986, Roberts 1987, Wershler 1991, Wagner 1997).

The goal of the reintroduction project is to re-establish breeding populations of northern leopard frogs in carefully chosen habitats in the Red Deer River and North Saskatchewan River drainages. Major objectives of the project include: the development and implementation of captive propagation, marking and release techniques needed to execute a successful reintroduction program; public promotion of the project and the leopard frog; and increased partnerships with a variety of organizations through co-operative work and shared research, knowledge and initiative.

2.0 STUDY AREA

2.1 Egg mass collection and frog release sites

The 2002 study area for the leopard frog project included egg mass collection locations in southern Alberta and frog release sites in the upper headwaters of the Red Deer and the North Saskatchewan Rivers (Figure 1).

The Raven River release site (release site 1) is situated near the Raven Brood Trout Station, southeast of the town of Caroline. A second pilot release site (release site 2) is located northeast of Crimson Lake Provincial Park, near Rocky Mountain House and along the North Saskatchewan River. A third release site (release site 3) is located south east of Red Deer. The 2002 egg mass collection site was located in the Bow City region of southern Alberta.

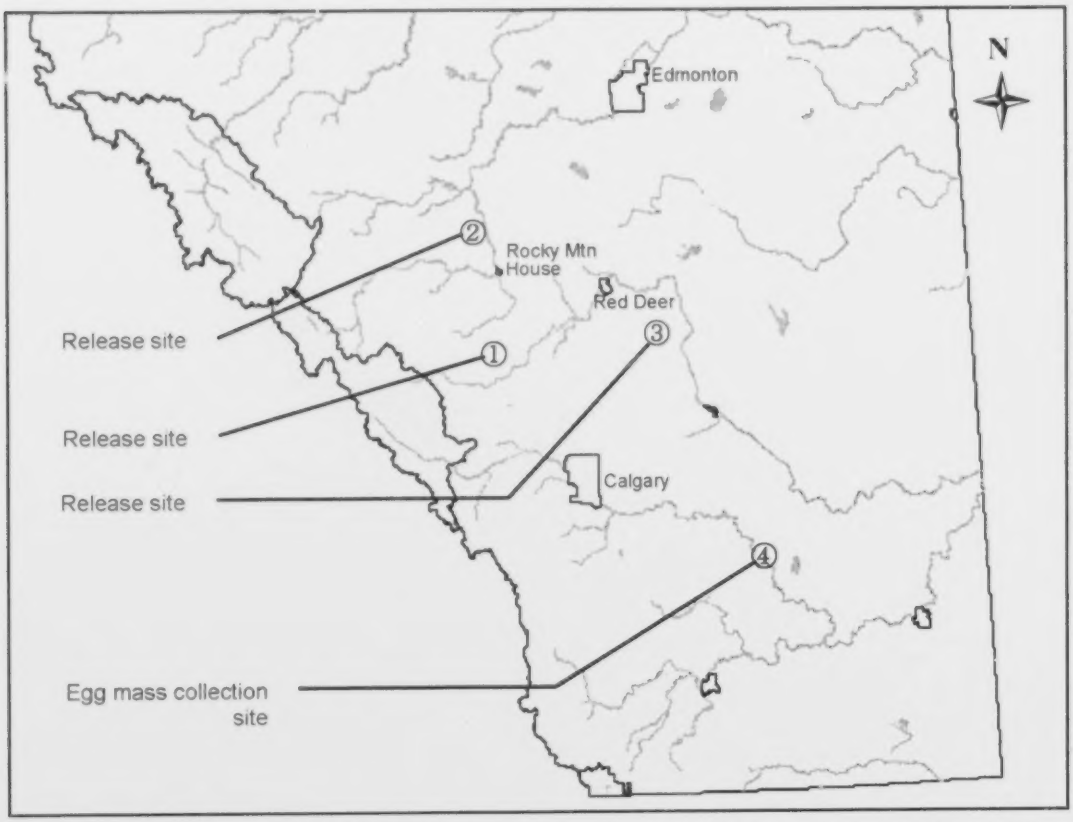

Figure 1. Alberta map depicting the release sites near Caroline (1), Rocky Mountain House (2) and Red Deer (3) as well as the area from which leopard frog egg masses were collected near Bow City (4).

2.2 Captive Rearing Site

For the fourth year, two large outdoor ponds (formerly used as trout raceways) at the Raven Brood Trout Station were used to rear leopard frogs from egg stage of development to fully metamorphed frogs. The Raven Brood Trout Station is an Alberta Sustainable Resource Development owned and operated facility. As in previous years, the artificial ponds (hereafter referred to as east and west rearing pond) and facility offered managed access, the ability to manipulate water depths and the means to confine captive-reared juvenile leopard frogs prior to being released into the wild. For a more detailed description of the rearing ponds see Kendell (2001).

Public promotion of the reintroduction project, presentations and interpretative events were also conducted at the Raven Brood Trout Station.

3.0 METHODS

3.1 Captive-rearing

3.1.1 Draw sites

Potential northern leopard frog breeding ponds were surveyed in the Brooks region of southern Alberta and along the Bow River near Arrowwood, east of Calgary and south of Gleichen. Surveys for egg masses occurred over two trips between 1 May and 9 May 2002.

Egg mass surveys were conducted in ideal spawning habitat identified in previous years (Kendell 2001) and under environmental conditions that favoured leopard frog breeding activity. The survey protocol for the northern leopard frog (Kendell 2002b) was also followed to help identify new breeding sites and conduct visual searches for egg masses at potential draw sites.

3.1.2 Egg mass and tadpole management

Egg masses were transported from their draw sites to the rearing site in 2-litre thermoses. At the halfway point of the trip, 50% of the water in each of the thermoses was replaced with fresh oxygenated water from its collection site. At the station, each egg mass and water from its thermos was transferred to a large plastic bag and floated for 20 minutes in an aquatic predator exclosure. After floating in the rearing ponds for 20 minutes, water from the rearing pond was gradually added to each plastic bag (over the 20-minute period) displacing and mixing with the water from the collection site. This helped to reduce any potential stress to the eggs associated with changes in water chemistry between the draw sites and the rearing ponds. Each egg mass was then transferred into an individual predator exclosure.

After complete hatch, the hatchling tadpoles were confined to the exclosures for about three weeks. By this time they were at the 20-26 stage of development based on Gosner's (1960) tadpole developmental staging system (see McDiarmid and Altig 1999). At this stage the tadpoles were free swimming and mobile.

3.1.3 Water management

Water depths in the two rearing ponds were maintained at the maximum level allowed by the standpipes fitted on the water control gates of each pond. At this level, the volume of water in the east and west rearing ponds were estimated to be 339 600 L (89 710 gallons) and 292 600 L (77 300 gallons), respectively. This estimated volume of water in both ponds did not take into account the displacement of water volume by the vegetation and other debris in the ponds. The maximum depth of water in each pond was approximately 80 cm (31.5 inches). Water lost through evaporation was replaced naturally through precipitation or, when needed, by the gradual input of spring water from the head pond.

3.1.4 Predator control

As in previous years, efforts were made to reduce the deleterious effect of predators on the tadpoles and young-of-the-year (YOY) frogs. These efforts included draining and flushing the ponds in the spring with fresh water, collecting and removing predatory aquatic insects and generally monitoring the ponds for terrestrial predator use. Identified potential predators from previous years include predaceous diving beetle larva (*Dytiscidae* sp.) and other predaceous aquatic invertebrates, great blue heron (*Ardea herodias*), belted kingfisher (*Ceryle alcyon*) and mink (*Mustela vison*).

Three rows of 14-gauge aluminium fence wire was erected parallel to the shore of each of the two rearing ponds to discourage use of the ponds by great blue heron. Each row of wire was separated by approximately 40 cm and the entire wire assembly was positioned approximately 75 cm above the shore and surface of the water. The multiple rows of wire allowed for a broad coverage of up to 1.2 m over the shallow water zone and the shore of the ponds providing a physical barrier and a relatively safe zone for tadpoles and young frogs to bask and forage for food.

3.1.5 Collection of captive-reared leopard frogs

Metamorphosed frogs were collected soon after the first completely transformed frogs were observed on the shore of the rearing ponds in noticeable numbers. Nets and funnel traps were used to capture the frogs. Each funnel trap contained 1 inch of water so that the frogs would not desiccate and the traps were left unchecked for no more than a 24-hour period. For a complete description of the funnel traps used in 2002, see Kendell (2001).

At the end of August, water levels in the rearing ponds were reduced to capture the remaining leopard frogs. The weight and snout-to-vent length (SVL) of every tenth frog captured for release into the wild was measured and recorded. While handling frogs during the marking stage, physical abnormalities such as missing limbs and wounds were generally noted.

3.1.6 Marking

Captive-reared leopard frogs were marked using a Visible Implant Elastomer (VIE) tagging system (Northwest Marine Technology, Inc. 2003). The tagging system provided an externally visible internal identification mark. The mark consisted of a fluorescent elastomer agent, that

when mixed with a curing agent, cured into a pliable solid within 24 hours. Using a 3/10 hypodermic syringe, this biocompatible agent was injected into the webbing between the fourth and fifth toe of the rear foot of each young frog. To reduce the activity level of the young frogs during the marking process, they were occasionally subjected to chilled (4-6 °C) spring water. Frogs released in 2002 were all marked on the left hind foot with a blue coloured elastomer.

3.2 Release (2002)

Captured captive reared frogs were transported to release sites using 70-litre tote bins. Moist vegetation was added to each bin and the bins were fashioned with air holes for ventilation. Frogs were released directly into suitable potential breeding habitat at their respective release site.

Each site possessed the potential availability of over-wintering, breeding and summer habitat necessary for the life history of the leopard frog. In addition, these sites supported dispersal opportunities into surrounding habitats and into the Red Deer or North Saskatchewan River drainage.

3.3 Leopard frog surveys

Leopard frog surveys began in May 2002 for frogs that were released in previous years at the Raven River release site. Early spring surveys focused on favourable leopard frog breeding habitat. Surveys continued through June and July at both the Raven River and North Saskatchewan River release sites. In both study areas, several wetlands downstream and further abroad from the immediate release sites were searched for leopard frogs.

4.0 RESULTS

4.1 Pubic involvement and promotion

As in previous years, public involvement and education were important components of the reintroduction project at the Raven Brood Trout Station. More than 100 volunteers were involved with the project, helping with the frog surveys and the collection, marking and releasing of captive reared frogs in August. Many of the volunteers, naturalist groups and school groups were given formal and informal presentations regarding the project, captive rearing program at the station and the natural history of Alberta's reptiles and amphibians.

Volunteers included members of the general public and individuals from the following organisations: Ducks Unlimited, Red Deer River Naturalist, Friends of Fish Creek Provincial Park, Friends of the Sam Livingston Fish Hatchery, personnel from Shell Canada Limited – Caroline Complex, The Calgary Zoo, Junior Forest Rangers, ACA and SRD. In addition, several media groups reported on the project including CBC radio and Red Deer television and 3 different newspapers.

4.2 Captive-rearing

4.2.1 Draw sites

In total, four egg masses were collected on 9 May 2002 from a single breeding pond located near Bow City in southern Alberta. Water quality information and environmental conditions at the draw site are detailed in Table 1.

Table 1. Water quality and environmental conditions recorded at the egg mass draw site at 11:00 on 9 May 2002.

Water quality / environmental parameter	**Measurement**
Air Temperature (at ground level)	15 °C
Water Temperature (approx. 4 cm below water surface)	12.5 °C
Dissolved Oxygen	7 ppm
KH (carbonate hardness / alkalinity)	270 ppm
GH (general hardness)	40 ppm
pH	8.2
Nitrate	0
Nitrite	0
Phosphate	0
Ammonia	0

ppm: Parts per million

Although potential breeding ponds were surveyed along the Bow River near Arrowwood, no egg masses or signs of breeding (calling frogs) were observed. However, two single leopard frogs were observed during the egg mass collection surveys and at that time were considered to be travelling to unidentified breeding locations in the area.

Several adult leopard frogs, and breeding activity (calling males), were documented at one location near Bow City during collection surveys for egg masses in the region. However, no egg masses were observed at that location during the period of surveys from 1 May 2002 to 9 May 2002.

The four egg masses collected at the 2002 draw site were likely deposited within one to three days prior to collection. Leopard frogs were not observed or heard calling at the draw site in which egg masses were collected.

4.2.2 Egg mass and tadpole management

Egg masses collected on 9 May began to hatch on 22 May, 13 days after they were collected and 14 to 16 days after they were likely deposited at the breeding site. In total, 12676 tadpoles were counted from the four egg masses collected in 2002. The overall productivity (percent of tadpoles that survived to metamorphosis) in the two rearing ponds in 2002 was greater than that of any previous year (Table 2). Of the 12676 living tadpoles introduced into the two ponds, 4191 metamorphs were captured, marked and released, representing a survival rate of 33%.

Table 2. Percent of tadpoles that survived to metamorphosis during each field season from 1999 to 2002 (Wendlandt and Takats 1999[1], Kendell 2001[2], Kendell 2002a[3]).

Year	No. of egg masses	No. of tadpoles hatched	No. of metamorphs	% Survival through from tadpole to metamorph
1999[1]	3	8292	1430	17 %
2000[2]	4	6692	1477	22 %
2001[3]	6	21036	2983	14 %
2002	4	12676	4191	33 %

Since the inception of the project in 1999, more than 6,500 leopard frogs have been released into the upper headwaters of the Red Deer River near Caroline. Over a two-year period beginning in 2001, 2,050 young frogs were released at a site along the North Saskatchewan River near Rocky Mountain House, Alberta. In 2002, a Ducks Unlimited wetland property, near Red Deer, was selected as a third release site. A total of 810 captive reared leopard frogs were released at that new site.

In 2003, the release of frogs commenced on 9 August, with frogs collected from both rearing ponds shortly after complete metamorphosis. Ninety-nine percent of the frogs reared in the two ponds at the station were collected and released at designated sites by 21 August (Table 3).

Table 3. Number of captive-reared leopard frogs captured for release from the east and west rearing ponds over the frog collection period in 2002.

Pond	9-Aug	10-Aug	12-Aug	14-Aug	16-Aug	19-Aug	20-Aug	21-Aug	10-Sep	11-Sep	Total # of frogs
East	398	220	360	470	100	400	92	22	32	9	2103
West	169		350		710	641		218			2088
Total	567	220	710	470	810	1041	92	240	32	9	**4191**

The remaining 1% of captive reared frogs were collected and released by 11 September. All 4191 frogs reared in 2002 were distributed and released at the three predetermined release sites: Raven River (RR), North Saskatchewan River (NSR) and Hummer Property (DU) between 9 August and 11 September 2002 (Table 4).

Table 4. Summary of release dates and total number of captive-reared leopard frogs released for each of the three release sites in 2002.

Release site	Date of releases										Total # of frogs
	9-Aug	10-Aug	12-Aug	14-Aug	16-Aug	19-Aug	20-Aug	21-Aug	10-Sep	11-Sep	
NSR	567		633								1200
RR		220	77	470		1041	92	240	32	9	2181
DU					810						810

NRS: North Saskatchewan River release site
RR: Raven River release site
DU: Ducks Unlimited Hummer Property release site.

4.2.3 Metamorphs

Summaries of the maximum, minimum and average SVL and weight of YOY leopard frogs procured at the Raven Brood Trout Station in 2002 are detailed in Table 5 and Table 6, respectively.

Table 5. The maximum, minimum and average SVL measurements, of all young-of-the-year captive-reared leopard frogs in 2002.

	Rearing Pond		
SVL (mm)	West (n^1=208)	East (n^1=205)	All (n^1=413)
Maximum	42	41	42
Minimum	25	22	22
Average	35.1	30.6	32.9

SVL: snout-vent-length measurement
[1] total number of frogs sampled

Table 6. The maximum, minimum and average weight measurements, of all young-of-the-year captive-reared leopard frogs in 2002.

	Rearing Pond		
Weight (grams)	West (n^1=208)	East (n^1=205)	East & West (n^1=413)
Maximum	8	5	8
Minimum	1.5	1.2	1.2
Average	4.8	3.2	4.0

[1] total number of frogs sampled

The average SVL of YOY leopard frogs, on 9 August or shortly after complete metamorphosis, collected from the west rearing and east-rearing pond were 34 mm (n=17) and 30 mm (n=38), respectively. The average weights of YOY leopard frogs on the same date, from the west and east-rearing pond, were 4 grams and 3 grams, respectively.

4.3 Leopard frog surveys

In total, seven leopard frogs were observed or captured in 2002 at the Raven River release site and at least three male leopard frogs were heard calling from a release pond at the same release site. One leopard frog egg mass was also observed in the pond from which the male frogs were heard calling. Local land users near the North Saskatchewan River release site submitted two unconfirmed leopard frog observation reports in 2002. Results from leopard frog surveys during the 2002 field season are detailed in Table 7.

Table 7. Leopard frog observations at the Raven River and North Saskatchewan River release sites in 2002.

Frog (sex)	Date	Activity	Tag information	Year of release	Release site
1 (male)	27 to 29 May	calling	NA (frog not observed)	unknown (1999 or 2000)	Raven River
2 (male)	27 to 29 May	calling	NA (frog not observed)	unknown (1999 or 2000)	Raven River
3 (male)	27 to 29 May	calling	NA (frog not observed)	unknown (1999 or 2000)	Raven River
4[1] (male)	27 to 29 May	calling	NA (frog not observed)	unknown (1999 or 2000)	Raven River
5 (unknown)	19 June	observed	NA (frog not captured)	unknown	Raven River
5[2] (NA)	19 June	egg mass	NA	NA	Raven River
6 (female)	24 June	captured	blue left foot	2001	Raven River
7 (?)	2 July	observed	NA	NA	Raven River
8 (female)	10 July	captured	blue left foot	2001	Raven River
9 (female)	7 August	captured	orange left foot	2000	Raven River
10[3] (?)	20 August	captured	no mark	unconfirmed (2002?)	Raven River
11 (male)	21 August	captured	green left foot	2000	Raven River
12[4] (?)	2002	observed	NA (frog not checked)	2001	North Saskatchewan River
13[4] (?)	2002	observed	NA (frog not checked)	2001	North Saskatchewan River

[1] fourth leopard frog in chorus unconfirmed
[2] confirmed leopard frog egg mass
[3] young-of-the-year observed approximately 1 km from Raven Brood Trout Station – unknown if this individual was procured in nature or was a dispersing frog from the station
[4] unconfirmed frog observation from members of the public – considered reliable

5.0 DISCUSSION

Today, remaining leopard frog populations primarily occur in south and southeast portions of the province; many of which are isolated and vulnerable to disturbance, disease and natural disasters that could potentially threaten these populations with local extinction. The long-term benefits of the leopard frog reintroduction project include increased biodiversity at release sites, the creation of a more stable and widespread leopard frog distribution in Alberta, and the contribution of knowledge and unique experiences to the general public that are involved with the project.

The public places a high value on threatened and endangered species that reflect the health and diversity of the environment in Alberta. With an increased sensitivity to environmental conditions, amphibians such as the leopard frog act as bio-indicators of the environment and are reliable barometers of an ecosystem's health. As with many amphibian species, the leopard frog plays an integral role in ecosystems in which they occur. In addition, the leopard frog is an important part of Alberta's natural heritage. Many people have grown up hearing the familiar calls of frogs on spring nights or have gone "frog-catching" during their childhood. The re-establishment of leopard frogs in historical areas would help ensure that current and future generations have the opportunity to appreciate leopard frogs as past generations have. Finally, the leopard frog reintroduction project offers a valuable opportunity for the general public to participate in a meaningful program, at the community level.

A major objective of the leopard frog reintroduction project is to successfully produce the largest and healthiest metamorphs possible for release. Larger metamorphs are more adapt at capturing prey, escaping predators, dispersing to and from important habitats (late summer foraging areas and hibernation sites), likely have a better chance of surviving hibernation (obtain greater fat/energy reserves) and are of a larger size at first breeding resulting in the deposition of a larger egg mass (Pough and Kamel 1984, Goater et al. 1993).

Throughout the 2002 rearing period, efforts to achieve optimum conditions for tadpole growth and development within the rearing ponds were attempted. However, because the rearing ponds exist in a semi-natural state, there are several variables that cannot be completely controlled, such as aquatic invertebrate communities, overall water temperatures (based on ambient air temperatures), potential disease outbreaks, and to a lesser extent avian and terrestrial predators. These variables not only play a role in the survival of the tadpoles, but also affect the size and weight of the metamorphs and potential survivorship of young frogs post emergence. Through timely manipulation of water levels within the rearing ponds and the surveillance of potential predators these threats can be reduced and result in a positive impact on the growth and development of the tadpoles.

Since the projects inception, efforts have been made to determine the optimum carrying capacity of the rearing ponds to minimize tadpole competition for the limited resources, such as food, shelter and space, within the rearing ponds. Ideally, optimum carrying capacity would take into consideration the deleterious effects of predators throughout tadpole development; however, under the current design of the project this is not possible.

Overall, limited information is available on the subject of metamorph size and weight in both wild and captive-reared leopard frogs. Some data suggests that young-of-the-year (YOY) may range 35-40 mm snout-to-vent-length (SVL) in Alberta (Yaremoko 1994). It is difficult to compare metamorphosed captive-reared frogs with those procured in nature because of the uncertainty of when the measurements were actually taken with respect to first emergence. However, with that said, this limited information may serve as the best existing benchmark.

In 2000, shortly after emergence, captive-reared leopard frogs had a SVL of 36-41 mm on average with a corresponding weight of 5 to 7g shortly after metamorphosis (Kendell 2001). In 2001, metamorphs were, on average, 33 mm and 4.2 g (Kendell 2002a). In 2002, data on YOY size and weight suggests similar results to 2001, with an average SVL of 33 mm and weight of 4 g. However, the number of YOY produced in 2002 increased by more than 1200 individuals compared to the previous year (2001). These results suggest progress in achieving our goal of producing the maximum number of frogs for release without sacrificing frog robustness and size as well as understanding the carrying capacity of the rearing ponds.

To date nearly 10,000 captive-reared leopard frogs have been released into designated release sites near Caroline, Rocky Mountain House and Red Deer, Alberta. Frog observations and evidence of breeding activity indicate preliminary success of the project at the initial release site (near Caroline, Alberta). The observation of at least 10 individual leopard frogs and documentation of calling activity in 2001, as well as the observation of several leopard frogs of various age classes and breeding activity in 2002 provides such evidence. Long-term monitoring at release sites will be critical to understanding dispersal rates, habitat use and general assessment of established populations leopard frogs.

6.0 MANAGEMENT IMPLICATIONS AND FUTURE DIRECTIONS

1. In order to produce the maximum number of young-of-the-year leopard frogs from the two rearing ponds at the Raven Brood Trout Station, without compromising metamorph health, it is recommended that 6 000 tadpoles be stocked into each rearing pond. To ensure at least 6 000 tadpoles are available for release into each rearing pond, at least 3 egg masses should be collected (each averaging at least 4 000 eggs). A fourth egg mass may be required when only small egg masses can be collected.

2. Selected release sites that demonstrated desired criteria favourable for a successful leopard frog reintroduction should be visited at least once during the winter, after freeze up, to assess over-wintering habitat suitability. Ice thickness, dissolved oxygen and water temperatures should be tested at each selected site.

3. Surveys for previously released frogs should be continued at all release sites and should be conducted in early spring, mid summer and again late summer. Additional late fall surveys could provide valuable information on waterbodies used for hibernation. Sampling guidelines outlined in the Survey Protocol for the Northern Leopard Frogs (Kendell 2001) should be used during the survey for leopard frogs at release sites.

4. Investigations into new potential leopard frog release site should be an on-going component of the Northern Leopard Frog Reintroduction Project. Having a number of release site options would ensure that only the best sites are considered and would more easily facilitate the addition of a new release site in event one of the existing release sites was determined to be unsuitable.

5. Long-term monitoring at all release sites is critical for general assessment of the potential successful establishment of released leopard frogs associated with this project.

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